

TRMM-LIS Lightning Climatology and Time Series

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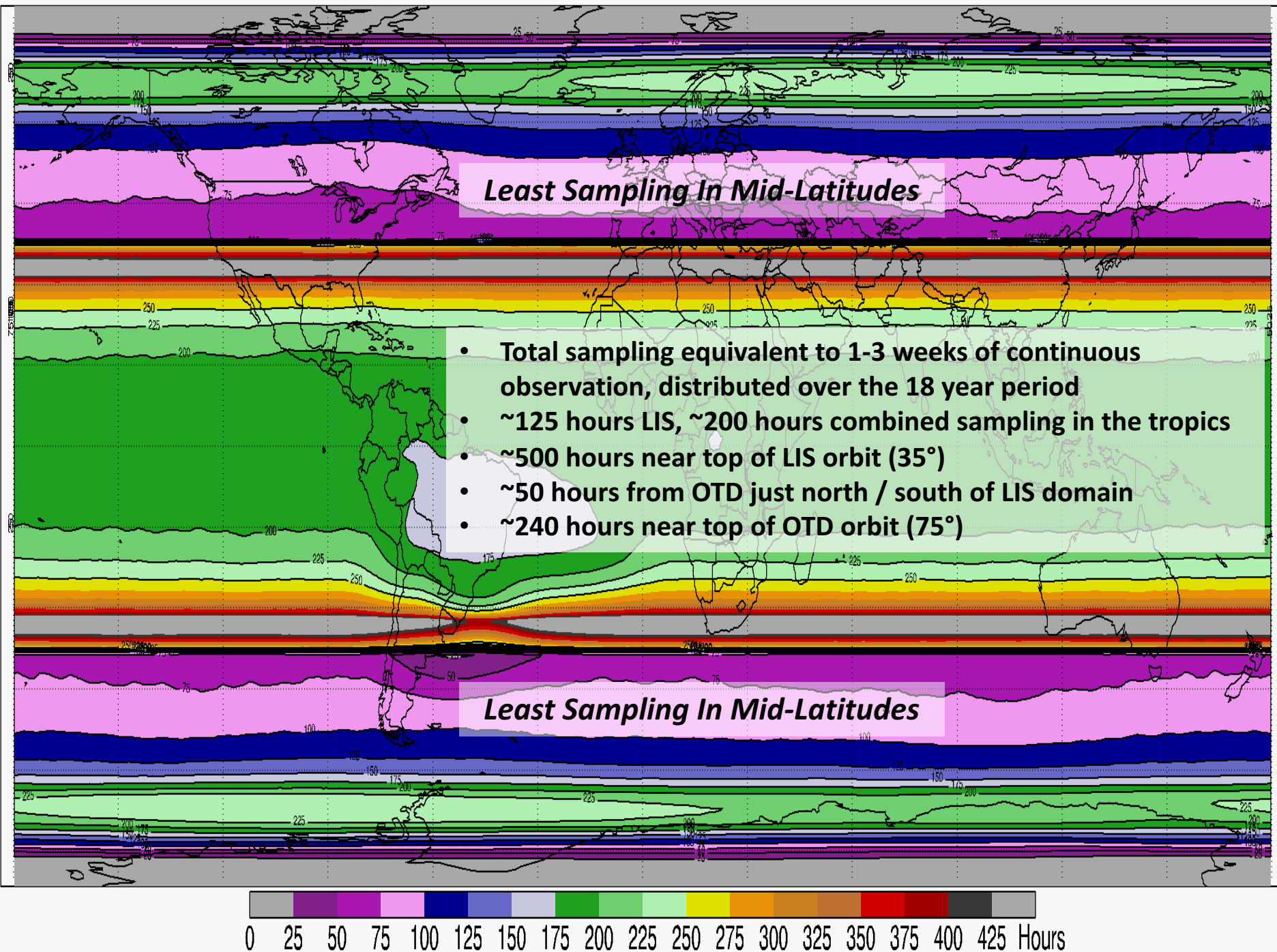
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Acknowledgements:

- **LIS/OTD Science Teams, support from NASA TRMM**
- **GHRC- hosting the LIS data**

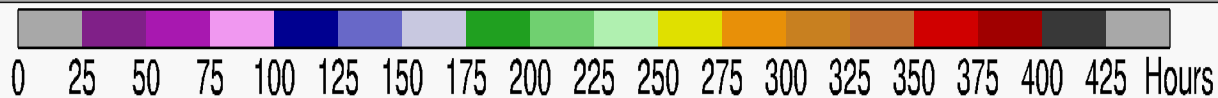
Hours of Sampling By LIS and OTD, 1995-2013



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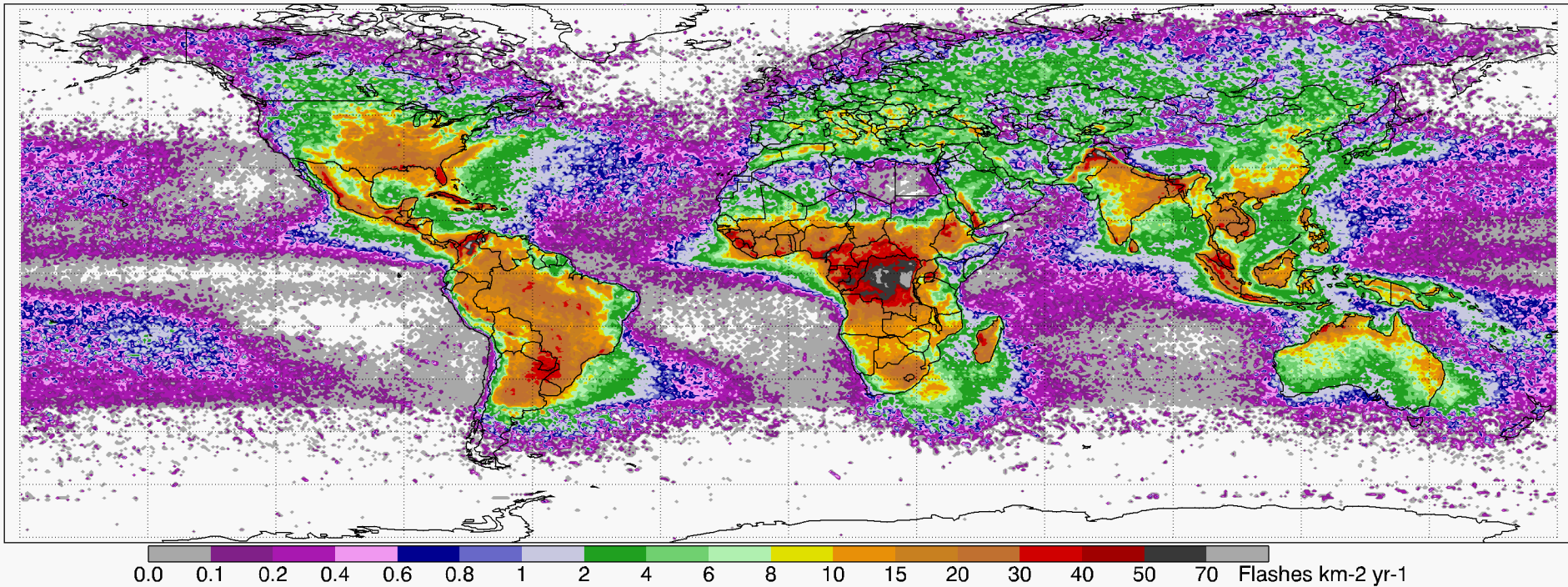
- *ISS LIS to launch in early 2017*
- *54° inclination orbit is nearly ideal for augmenting the previous LIS-OTD sample size*

After about a 2-year gap, time series products of lightning flash rate can be resumed



Annual Mean Total Lightning Flash Rate from TRMM-LIS and OTD (1995-2014)

HRFC_COM_FR



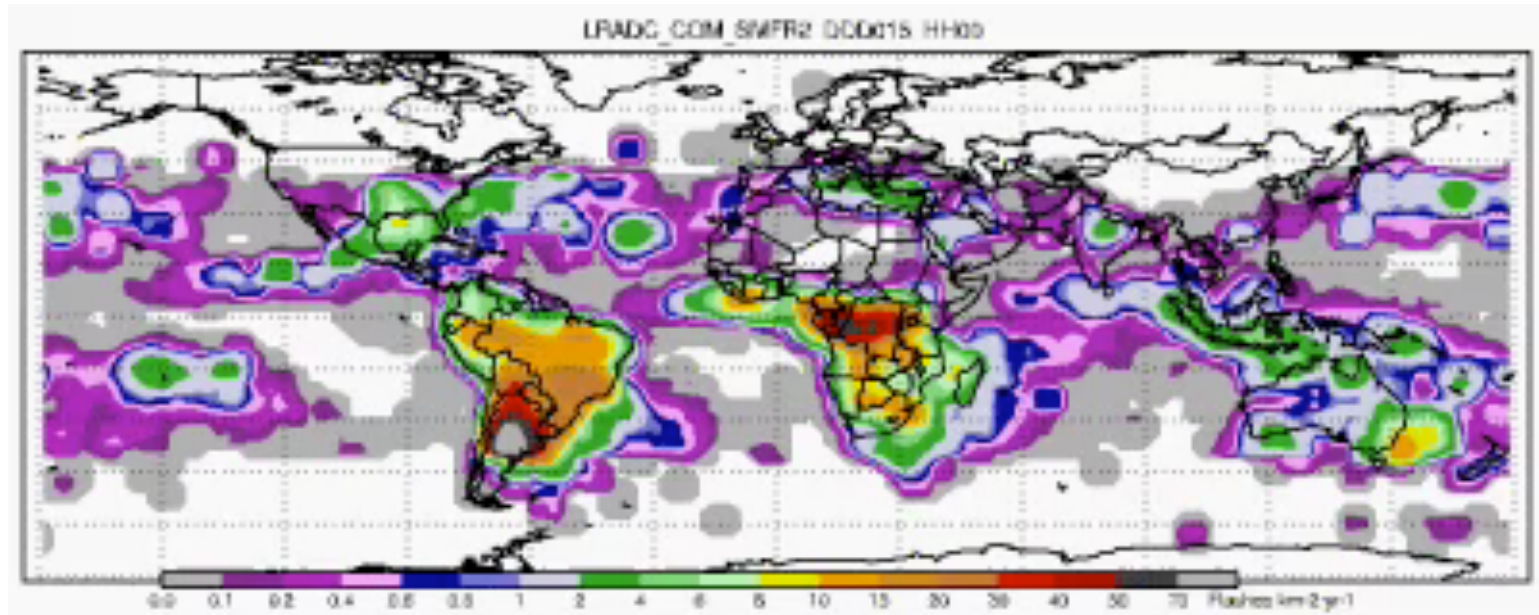
From a simple counting experiment, the total number of flashes observed divided by the total observation duration for each 0.5° grid box

Annual Cycle, Diurnal Cycle, Inter-Annual Variability

As the data volume grows large, we can examine finer details and get robust results:

- Annual Cycle
- Diurnal Cycle
- Diurnal Cycle, as it varies through the year
- Inter-Annual Variability

Mean Annual and Diurnal Cycles from TRMM-LIS and OTD (1995-2014)



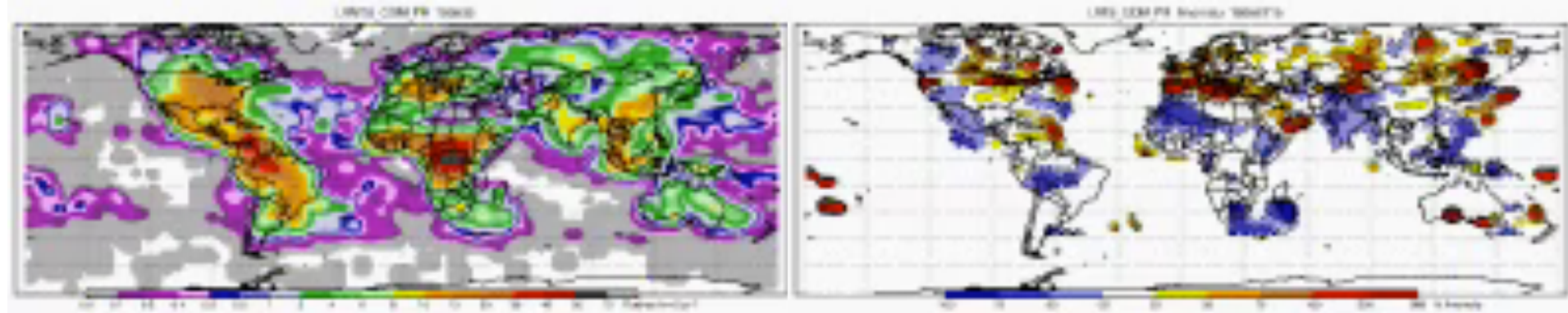
Animation of Diurnal Cycle (in UTC), separately for each month

Good data for analyzing this in the tropics already, but ISS-LIS will make characterization of mid-latitudes much more robust

Time Series of Flash Rate from TRMM-LIS and OTD (1995-2014)

Monthly Flash Rate

Percentage Anomaly

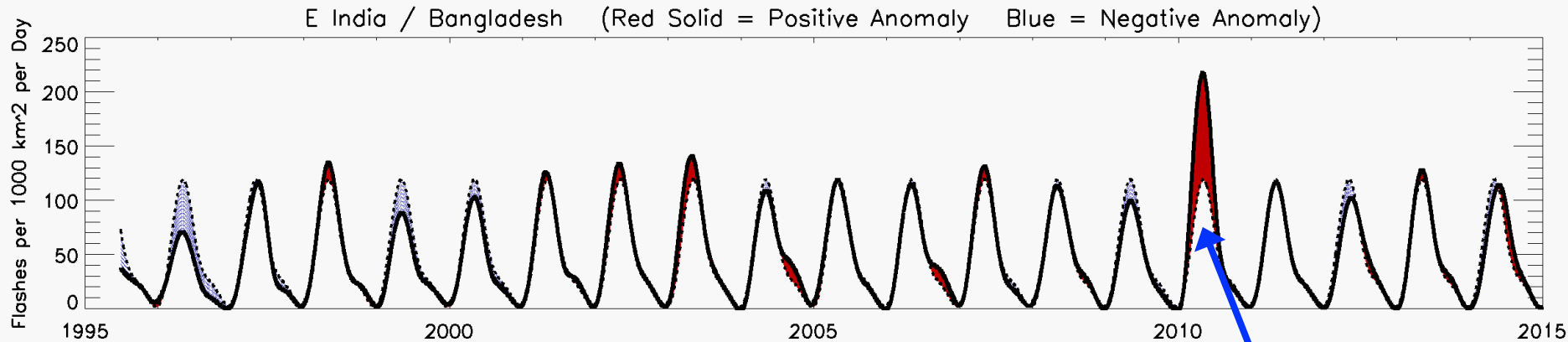


The long record from OTD and TRMM-LIS allows comparisons of different years

Most of the big *percentage* anomalies (at right) are for regions / seasons that do not get much lightning climatologically (e.g., deserts, oceans).

Absolute anomalies can also be plotted, which would highlight only the regions / seasons that do get a lot of lightning.

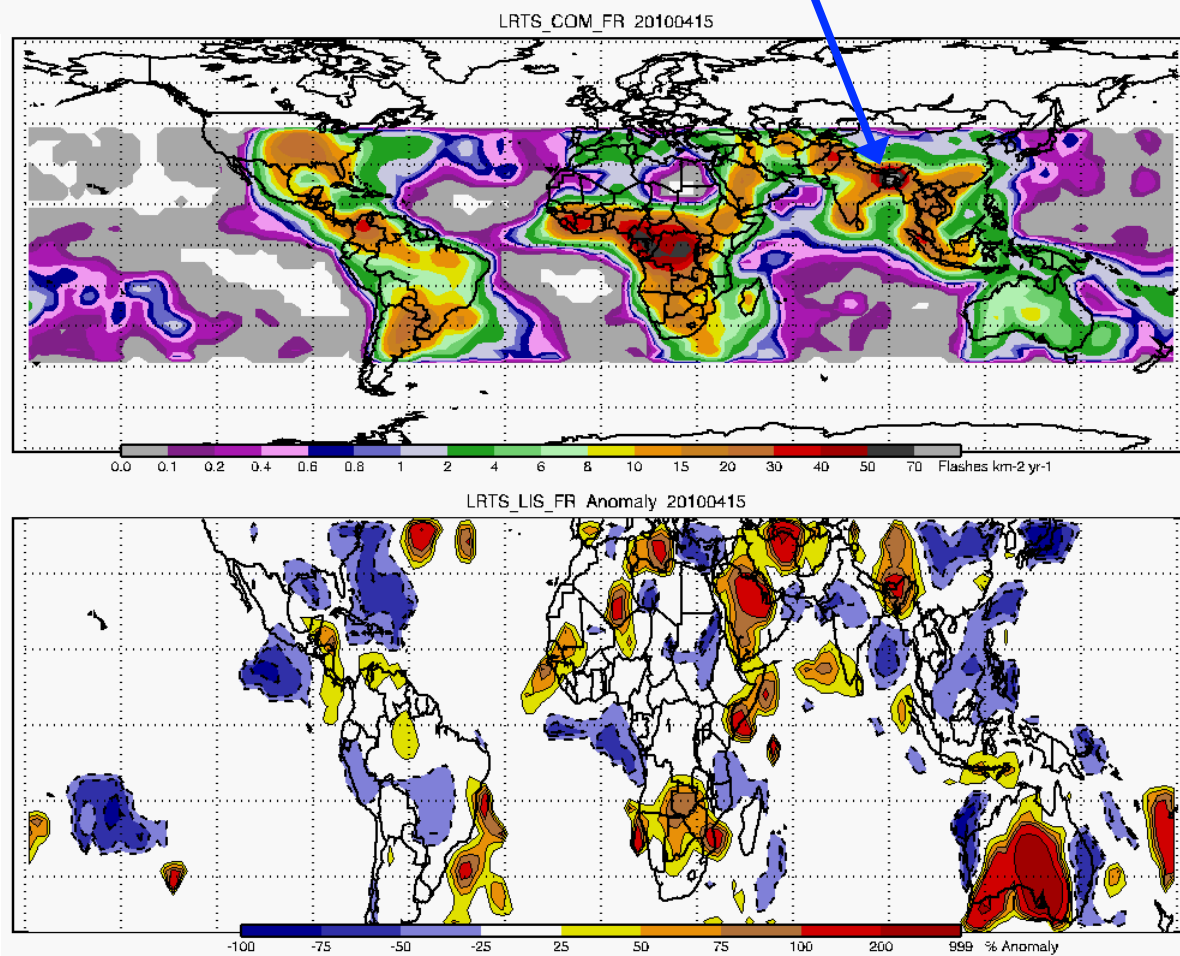
Time Series products have ~3-month temporal smoothing, 7.5° spatial smoothing

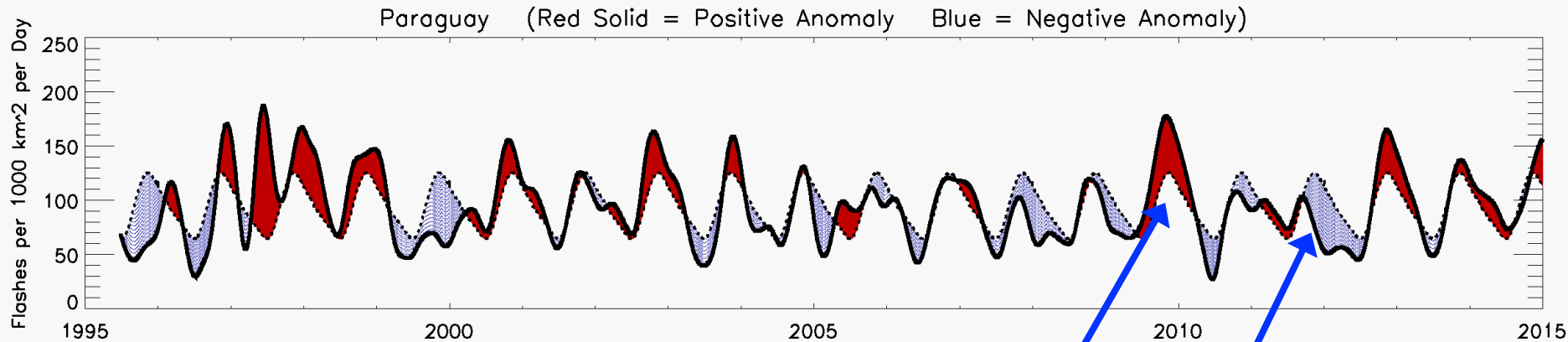


Top: Flash Rate Time Series and Anomalies for a box including **East India and Bangladesh**

For this region, most years are pretty close to normal in terms of total flash rate. 2010 was a huge (positive) anomaly.

Right: Mean flash rate for **March-April-May 2010**, and percentage anomaly from the March-April-May mean

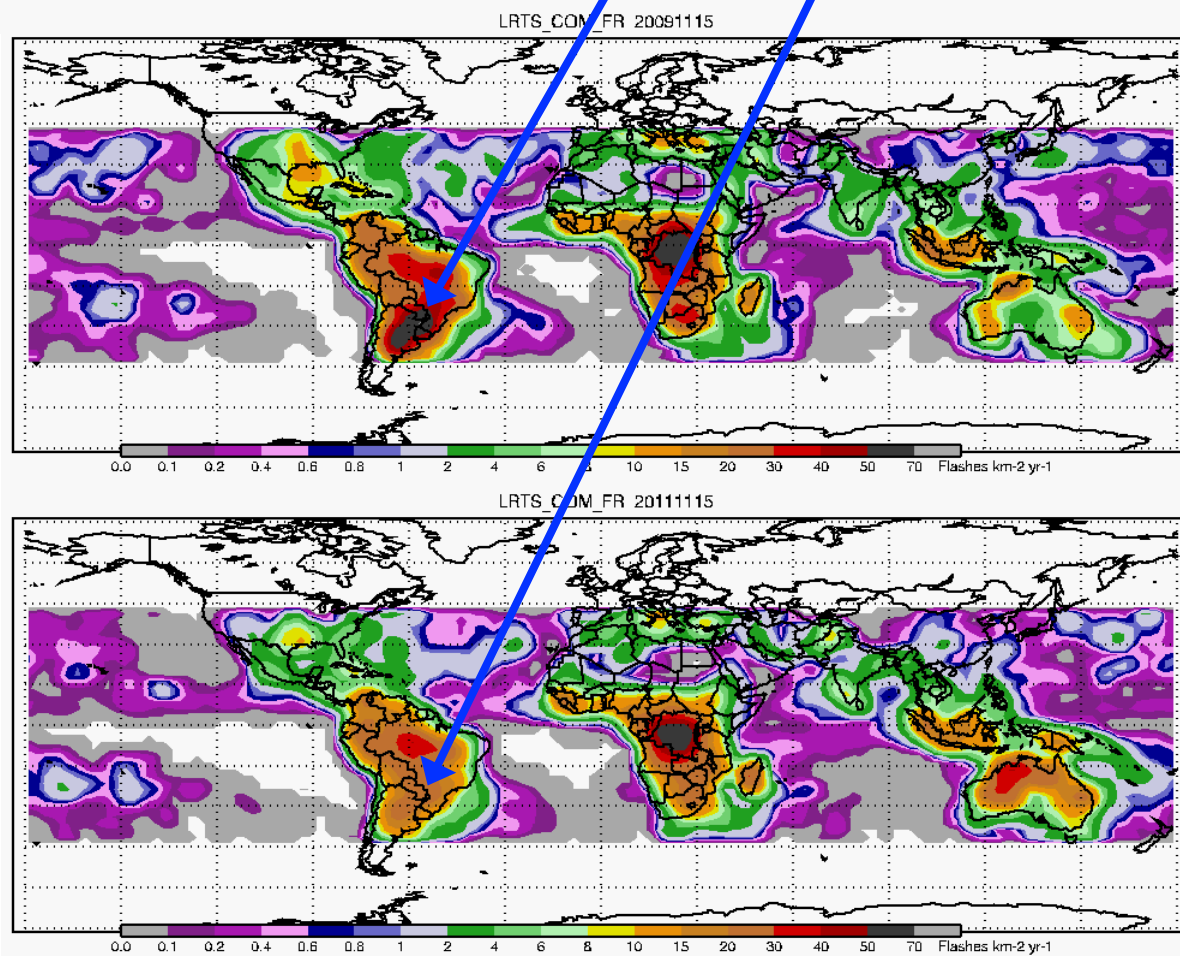




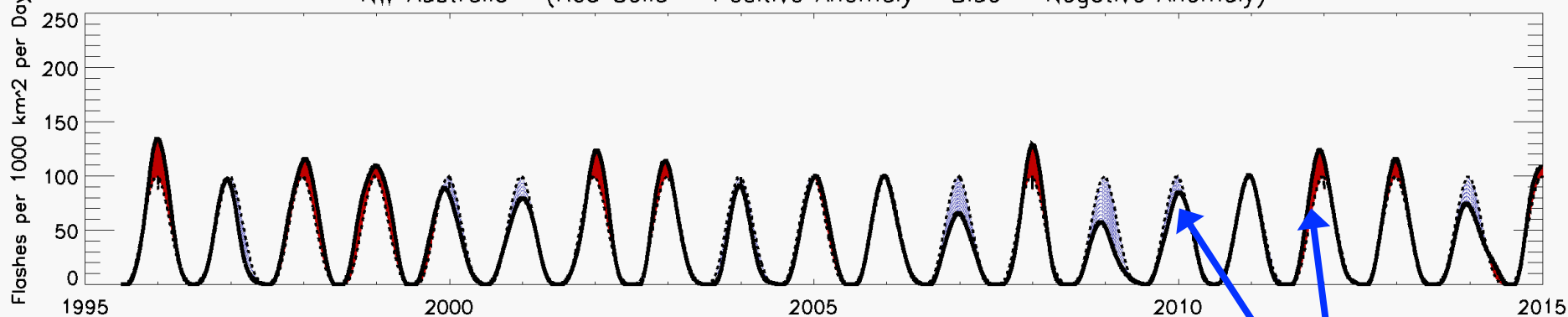
Top: Flash Rate Time Series and Anomalies for a box including **southern Paraguay**

For this region, “normal” almost never happens. Most years are either abnormally active or inactive.

Right: Mean flash rate for **Oct-Dec 2009 (top right)**, and **Oct-Dec 2011 (bottom right)**.



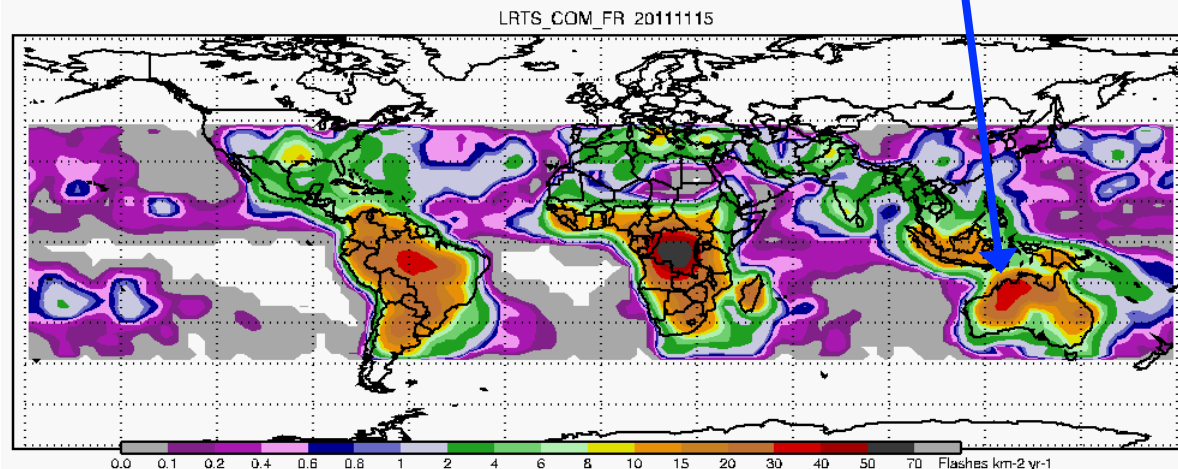
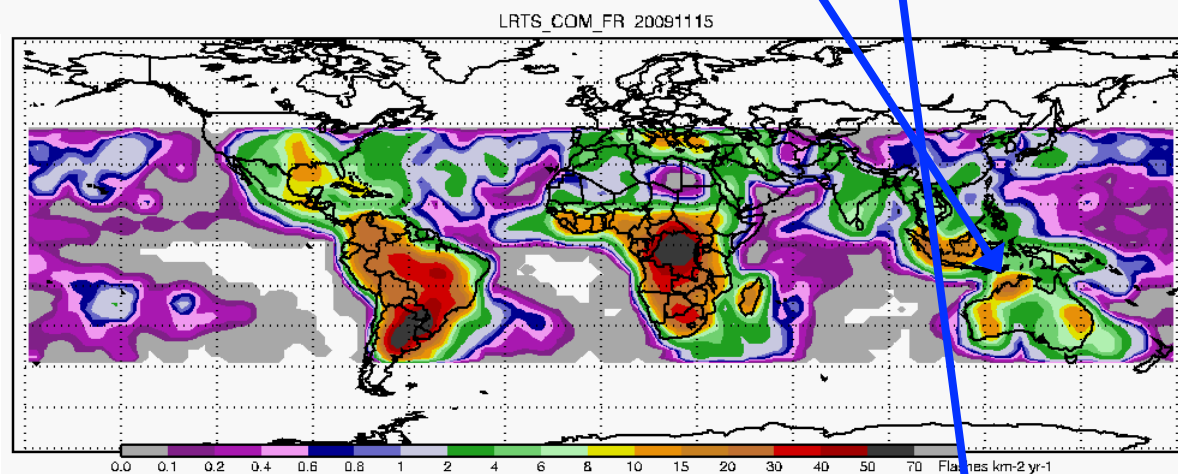
NW Australia (Red Solid = Positive Anomaly Blue = Negative Anomaly)



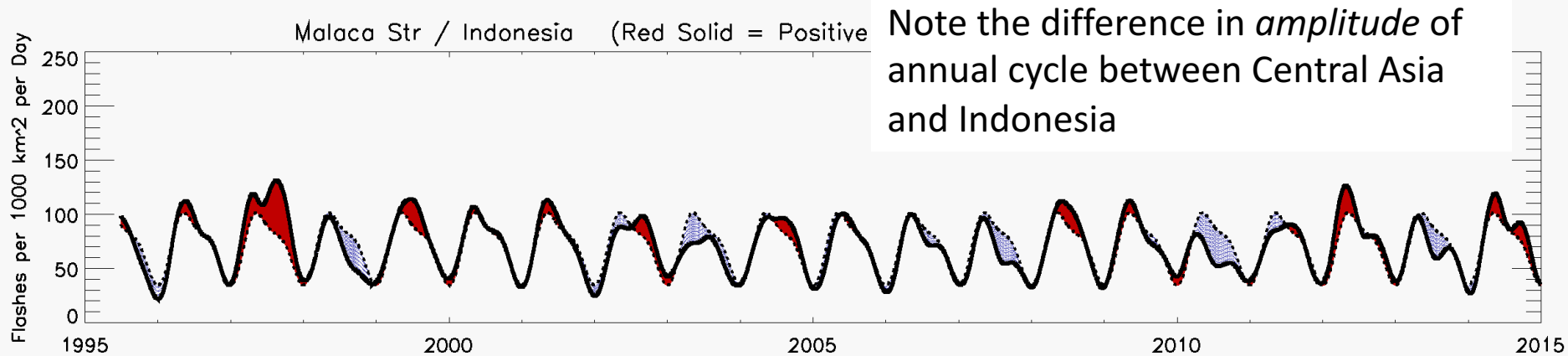
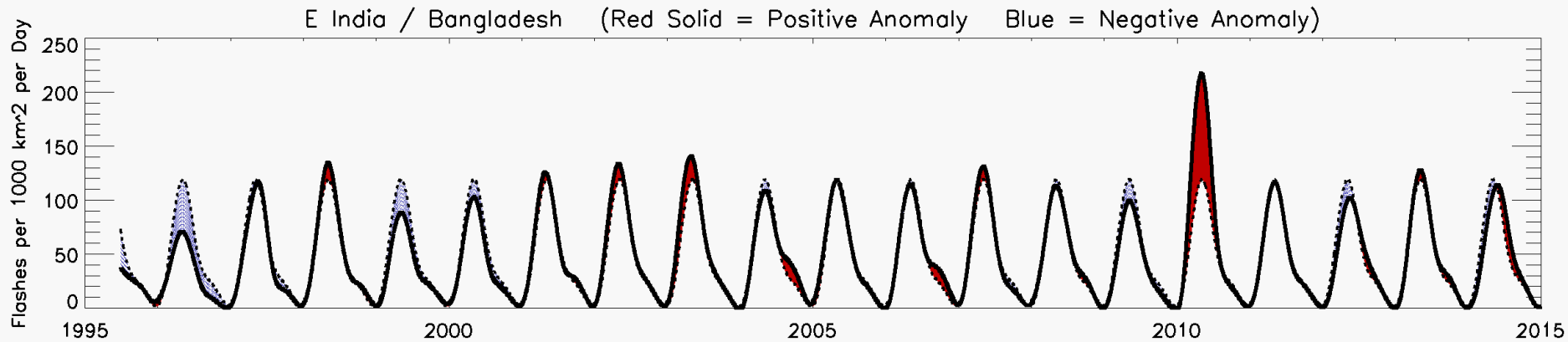
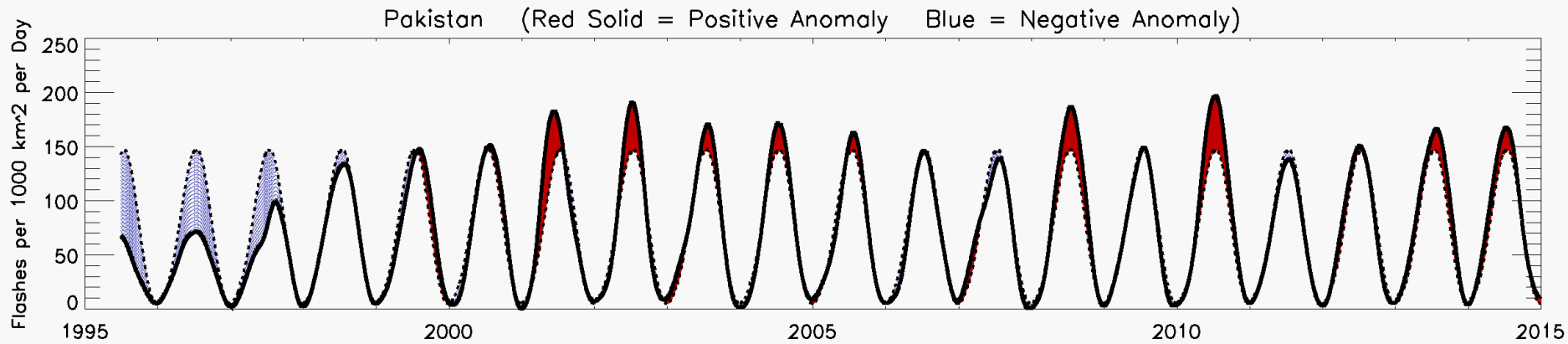
Top: Flash Rate Time Series and Anomalies for a box including **northwestern Australia**

For this region, some years have pretty normal lightning flash rates, some years are particularly active or inactive

Right: Mean flash rate for **Oct-Dec 2009 (top right)**, and **Oct-Dec 2011 (bottom right)**.

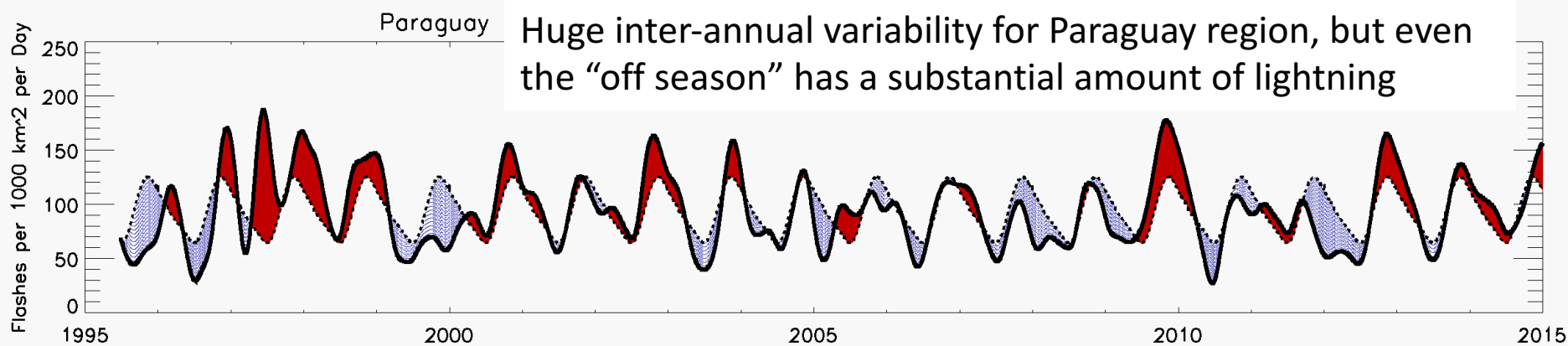
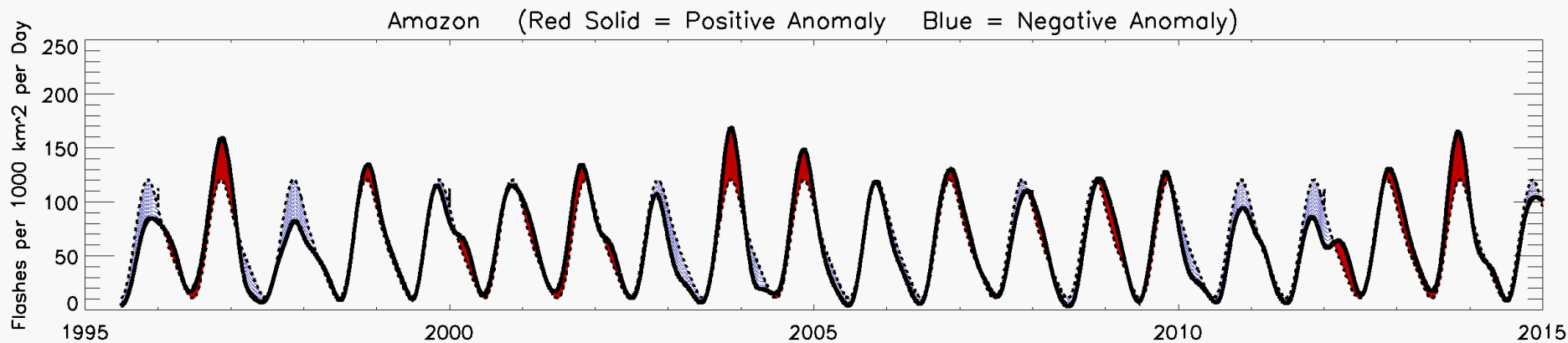
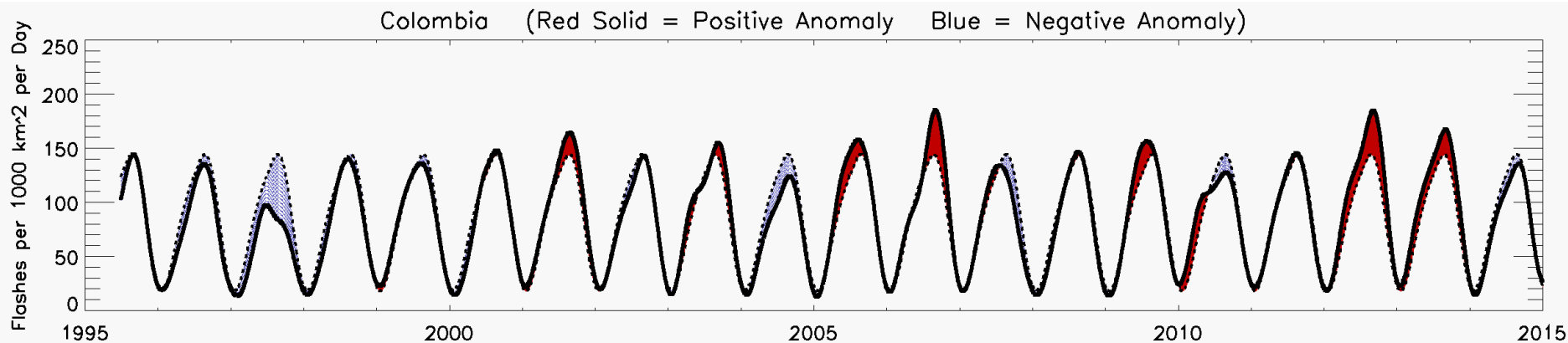


Central Asia and Indonesia



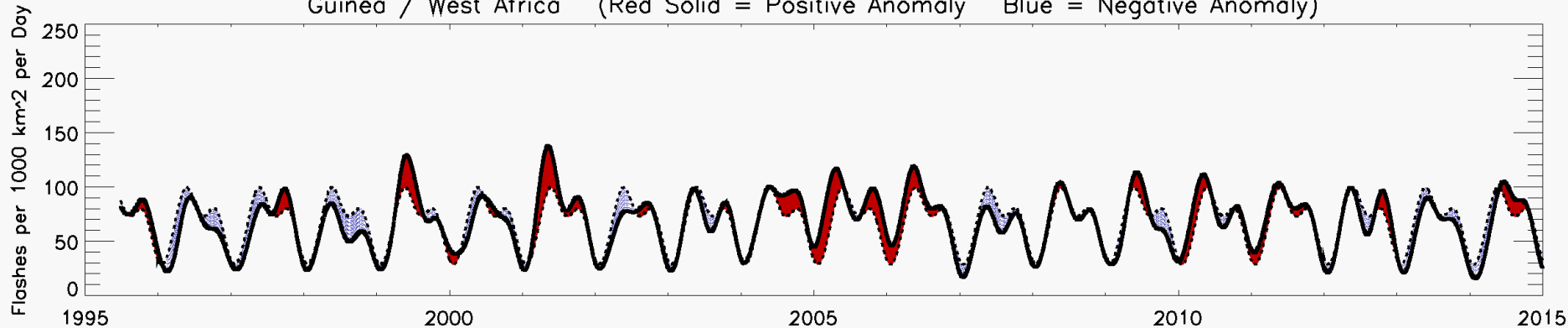
Note the difference in *amplitude* of annual cycle between Central Asia and Indonesia

South America

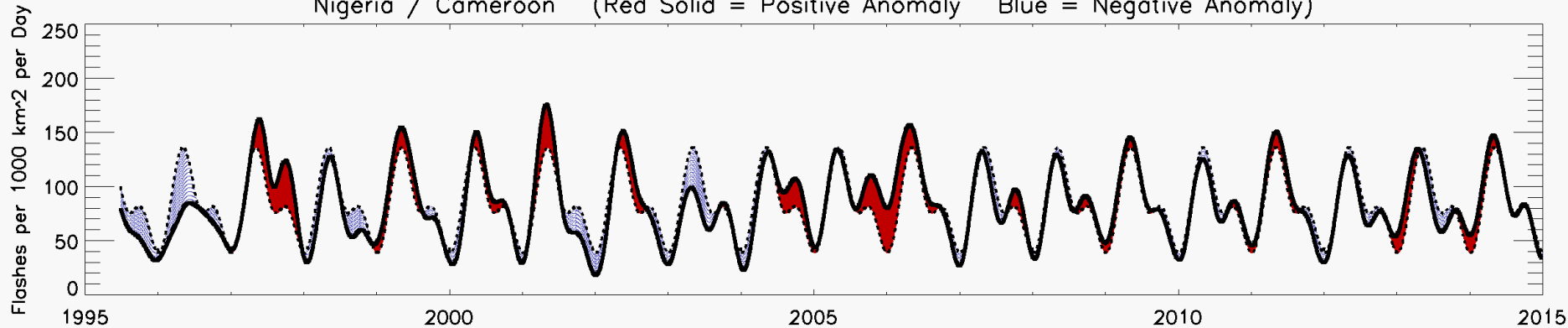


Africa

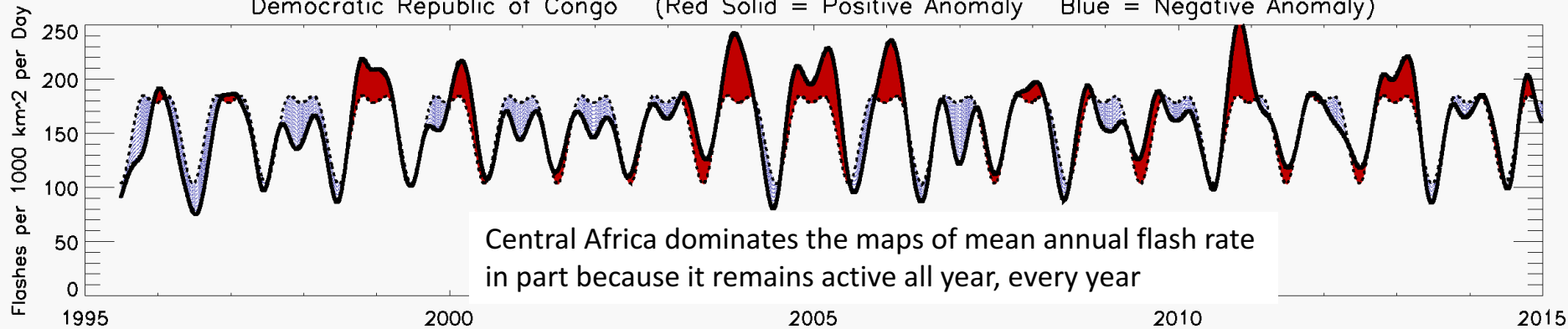
Guinea / West Africa (Red Solid = Positive Anomaly Blue = Negative Anomaly)



Nigeria / Cameroon (Red Solid = Positive Anomaly Blue = Negative Anomaly)



Democratic Republic of Congo (Red Solid = Positive Anomaly Blue = Negative Anomaly)



Central Africa dominates the maps of mean annual flash rate in part because it remains active all year, every year

Data available from GHRC, pretty easy to use, lots of ways to look at the datasets

https://lightning.nsstc.nasa.gov/data/data_lis-otd-climatology.html



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The Lightning Team

A Lightning Primer

Dataset Information

Space Research and Observations

Field Campaigns and Ground Validation

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Global Lightning Image

Global lightning strikes from January 1998 to present day from the NASA/MSFC Lightning Imaging Sensor



US Dept of State Geographer
© 2016 Google
© 2009 GeoBasis-DE/BKG
© 2016 Basarsoft

Google Earth

Please Note: The images for the Google Earth animation will be downloaded first to your browser. This process may take longer if your network is slow. Use the slider to advance through the images. HRAC, HRMC, LRAC, LRDC, and LRADC use averages over the entire length of the satellite missions. The slider incorrectly lists a single year for those, in order to make this Google Earth functionality work. LRTS and LRMTS images do in fact represent data from particular individual years.

LIS/OTD Gridded Lightning Climatology Data Sets

The LIS/OTD Climatology data sets consist of gridded climatologies of total lightning flash rates seen by the spaceborne Optical Transient Detector (OTD) and Lightning Imaging Sensor (LIS).

Documentation:

- Gridded lightning climatology from TRMM-LIS and OTD: Dataset description
- LIS/OTD Gridded Lightning Climatology Data Sets Guide
- LIS/OTD Climatology Product Description Table
- LIS/OTD Climatology Data Reader Code
- LIS/OTD Climatology Grid Reader Code



High Resolution Full Climatology (HRFC)

Data: LIS/OTD 0.5 Degree High Resolution Full Climatology (HRFC)

Browse: HRFC_COM_FR_V2.3.2014.png



Low Resolution Full Climatology (LRFC)

Data: LIS/OTD 2.5 Degree Low Resolution Full Climatology (LRFC)

Browse: LRFC_COM_FR_V2.3.2014.png



Low Resolution Diurnal Climatology (LRDC)

Data: LIS/OTD 2.5 Degree Low Resolution Diurnal Climatology (LRDC)

Animation: LRDC_COM_V2.3.2014.mov



Low Resolution Annual Diurnal Climatology (LRADC)

Data: LIS/OTD 2.5 Degree Low Resolution Annual Diurnal Climatology (LRADC)

Animations: LRADC_COM_SMFR_V2.3.2014.mov
LRADC_COM_SMFR_V2.3.2014.mov



High Resolution Monthly Climatology (HRMC)

Data: LIS/OTD 0.5 Degree High Resolution Monthly Climatology (HRMC)

Animations: HRMC_COM_V2.3.2014.mov
HRMC_COM_V2.3.2014.mov



High Resolution Annual Climatology (HRAC)

Data: LIS/OTD 0.5 Degree High Resolution Annual Climatology (HRAC)

Animation: HRAC_COM_V2.3.2014.mov



Low Resolution Annual Climatology (LRAC)

Data: LIS/OTD 2.5 Degree Low Resolution Annual Climatology (LRAC)

Animation: LRAC_COM_V2.3.2014.mov



Low Resolution Annual Climatology Time Series (LRACTS)

Data: LIS/OTD 2.5 Degree Low Resolution Annual Climatology Time Series (LRACTS)

Animation: LRACTS_COM_V2.3.2014.mov



Low Resolution Time Series (LRTS)

Data: LIS/OTD 2.5 Degree Low Resolution Time Series (LRTS)

Animations: LRTS_COM_V2.3.2014.mov

Notice: Users are strongly encouraged to choose the LIS/OTD 2.5 Degree Low Resolution Monthly Time Series (LRMTS) data set over the LIS/OTD 2.5 Degree Low Resolution Time Series (LRTS) data set. Both products have ~3 month smoothing, so the 'daily data' adds little useful information compared to that in the much smaller LRMTS files.



Low Resolution Monthly Time Series (LRMTS)

Data: LIS/OTD 2.5 Degree Low Resolution Monthly Time Series (LRMTS)

Animation: LRMTS_COM_V2.3.2014.mov

feedback